WKS
Ideal Gas Law

NAME Answer Key
Period _____ **Date** _____

PV = nRT	P is pressure, in atm or kPa V is volume in liters (L)	n is number of moles R is the ideal gas constant = 0.08206 $\frac{L\cdot atm}{mol\cdot K}$ = 8.314 $\frac{L\cdot kPa}{mol\cdot K}$ T is temperature in Kelvin (K)

1) A student collects 425 mL of oxygen at a temperature of 24°C and a pressure of 0.899 atm. How many moles of O_2 did she collect? [remember to convert volume to L and temperature to K!]

$$T = 24°C + 273 = 297\ K; V = 425\ mL \times \frac{1\ L}{1000\ mL} = 0.425\ L$$

$$PV = nRT \rightarrow n = \frac{PV}{RT};\ n = \frac{(0.899\ \cancel{atm})(0.425\ \cancel{L})}{\left(0.08206\ \frac{\cancel{L}\cdot\cancel{atm}}{mol\cdot\cancel{K}}\right)(297\ \cancel{K})} = \boxed{0.0157\ mol}$$

2) What is the volume of 1.50 moles of an ideal gas at 25°C and a pressure of 0.915 kPa?

$T = 25°C + 273 = 298\ K$

$$PV = nRT \rightarrow V = \frac{nRT}{P};\ V = \frac{(1.50\ \cancel{mol})\left(8.314\ \frac{L\cdot\cancel{kPa}}{\cancel{mol}\cdot K}\right)(298\ \cancel{K})}{(0.915\ \cancel{kPa})} = \boxed{4060\ L}$$

3) What pressure, in atm, will 1,360 g of N_2O gas [convert to moles!] exert on its cylinder with volume of 25.0 L if stored in a shed whose temperature reaches 59°C in the summer?

$$T = 59°C + 273 = 332\ K;\ n = 1360\ g\ N_2O \times \frac{1\ mol}{44.02\ g} = 30.90\ mol\ N_2O$$

$$PV = nRT \rightarrow P = \frac{nRT}{V};\ P = \frac{(30.90\ \cancel{mol})\left(0.08206\ \frac{\cancel{L}\cdot atm}{\cancel{mol}\cdot K}\right)(332\ \cancel{K})}{(25.0\ \cancel{L})} = \boxed{33.7\ atm}$$

4) A tank with a volume of 658 mL contains 1.50 g of Ne gas at a pressure of 450. kPa. What is the temperature of the gas, in °C?

$$V = 658\ mL \times \frac{1\ L}{1000\ mL} = 0.658\ L;\ n = 1.50\ g\ Ne \times \frac{1\ mol}{20.18\ g} = 0.0743\ mol\ Ne;\ PV = nRT \rightarrow T = \frac{PV}{nR};$$

$$T = \frac{(450.\ \cancel{kPa})(0.658\ \cancel{L})}{\left(8.314\ \frac{\cancel{L}\cdot\cancel{kPa}}{\cancel{mol}\cdot K}\right)(0.0743\ \cancel{mol})} = 479\ K;\ T = 479\ K - 273 = \boxed{206°C}$$

5) What mass of boron trifluoride gas will occupy a volume of 18.5 L at a temperature of 78.0°C and a pressure of 925 mmHg? [Think: what do you need to convert!?]

$T = 78.0°C + 273 = 351\ K;\ P = 925\ mmHg/760\ mmHg = 1.22\ atm$

$$PV = nRT \rightarrow n = \frac{PV}{RT};\ n = \frac{(1.22\ \cancel{atm})(18.5\ \cancel{L})}{\left(0.08206\ \frac{\cancel{L}\cdot atm}{mol\cdot\cancel{K}}\right)(351\ \cancel{K})} = 0.784\ mol$$

$$mass\ BF_3 = 0.781\ mol\ BF_3 \times \frac{67.81\ g\ BF_3}{1\ mol\ BF_3} = \boxed{53.1\ g\ BF_3}$$

[Over]

6) How many grams of gas are present in a sample that has a molar mass of 70.0 g/mol and occupies a 2.00-L container at 117 kPa and 35.1°C?

$T = 35.1°C + 273 = 308\ K$

$$PV = nRT \rightarrow n = \frac{PV}{RT};\ n = \frac{(117\ \cancel{kPa})(2.00\ \cancel{L})}{\left(\frac{mol \cdot \cancel{K}}{8.314\ \cancel{L} \cdot \cancel{kPa}}\right)(308\ \cancel{K})} = 0.0914\ mol$$

$$mass = 0.0914\ mol \times \frac{70.0\ g}{1\ mol} = \boxed{6.40\ g}$$

7) A student measures that 12.18 grams of a gas has a volume of 2.75 L at 714 torr (remember, 1 torr = 1 mmHg) and 125°C?

a) How many moles of gas were present?

$$T = 125.0°C + 273 = 398\ K;\ P = 714\ \cancel{torr} \times \frac{1\ atm}{760\ \cancel{torr}} = 0.939\ atm$$

$$PV = nRT \rightarrow n = \frac{PV}{RT};\ n = \frac{(0.939\ \cancel{atm})(2.75\ \cancel{L})}{\left(\frac{mol \cdot \cancel{K}}{0.08206\ \cancel{L} \cdot \cancel{atm}}\right)(398\ \cancel{K})} = \boxed{0.0791\ mol}$$

b) What is the molar mass of the gas?

$$\text{Molar Mass} = \frac{\text{mass of gas}}{\text{moles of gas}} = \frac{12.18\ g}{0.0790\ mol} = \boxed{154\ g/mol}$$

or use PM = DRT: $M = \frac{DRT}{P}$

$$M = \frac{\left(\frac{12.18\ g}{2.75\ L}\right)\left(0.08206\ \frac{L \cdot atm}{mol \cdot K}\right)(398\ K)}{0.939\ atm} = \boxed{154\ g/mol}$$

8) A sample of gas has a density of 1.09 g/L at 1.02 atm pressure and 25.0°C.

a) How many moles of gas are present?

$T = 25.0°C + 273 = 298\ K$; assume V = 1.00 L, so mass = 1.09 g

$$PV = nRT \rightarrow n = \frac{PV}{RT};\ n = \frac{(1.02\ \cancel{atm})(1.00\ \cancel{L})}{\left(\frac{mol \cdot \cancel{K}}{0.08206\ \cancel{L} \cdot \cancel{atm}}\right)(298\ \cancel{K})} = \boxed{0.0417\ mol}$$

b) What is the molar mass of the gas?

$$\text{Molar Mass} = \frac{\text{mass of gas}}{\text{moles of gas}} = \frac{1.09\ g}{0.0417\ mol} = \boxed{26.1\ g/mol}$$

or use PM = DRT: $M = \frac{DRT}{P}$

$$M = \frac{\left(\frac{1.09\ g}{1\ L}\right)\left(0.08206\ \frac{L \cdot atm}{mol \cdot K}\right)(298\ K)}{1.02\ atm} = \boxed{26.1\ g/mol}$$